HPB, 2005; 7: 180–182

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REVIEW ARTICLE

The role of the anesthesiologist as an integral member of the transplant team

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Becoming a UNOS (United Network for Organ Sharing) approved liver transplant center requires a qualified and approved transplant surgeon and hepatologist. However, no mention is made of a certified anesthesiologist. The complexity of liver transplant patients requires constant interaction between the anesthesiologist and the rest of the transplant team. The transplant anesthesiologist must become active in many traditional and non-traditional roles to ensure a successful outcome of the transplant procedure and program as a whole. Previously, we described the role of the anesthesiologist in initiating a program [1]. Although the roles are similar, and much of this paper is based on that article, in this article we attempt to define, refine, and update those roles further.

Training/experience

Liver transplantation is clearly not 'just another big case'. The pathophysiology of end-stage liver disease and its implications for care of the transplant patient must be understood clearly. In addition, the unique technical aspects of the transplant procedure require experience and understanding prior to shouldering the responsibility of caring for these patients. Therefore, we feel every major transplant program should have at least one highly trained transplant anesthesiologist leading the transplant anesthesia team. While the definition of 'highly trained' is up for interpretation, this individual should be comfortable with a variety of concepts specific to liver transplantation. For example, the anesthesiologist should be comfortable with the implications and management the following: veno-venous bypass, the piggy-back technique, veno-caval cross clamping, the reperfusion syndrome, massive transfusion, monitoring and treatment of coagulation abnormalities, intraoperative continuous renal replacement therapy, and the rapid infusion system. In addition, experience with fulminant hepatic failure, portopulmonary hypertension, hepatopulmonary syndrome, and multi-organ transplantation is essential.

Once a trained liver transplant anesthesiologist is in place, he/she can begin recruiting and training other interested attending anesthesiologists to form a team. The additional anesthesiologists can be trained in an 'on-the-job' type fellowship, mentoring this person through the entire case at first, with increasing responsibility over time. In our experience, it takes about 15–20 cases before the more junior anesthesiologist feels comfortable and is ready to work unsupervised. At this point, a call schedule can be developed and the responsibilities can be shared. However, the team leader must always be available for backup as different situations and emergencies arise.

Perioperative management

The perioperative management of liver transplant patients is clearly where the trained liver transplant anesthesiologist can have tremendous influence. In addition to the critical role in intraoperative management, he/she provides key input into the other pre- and postoperative aspects of transplantation. For example, the anesthesiologist adds important expertise in the initial patient evaluation and patient selection as well as follow-up, and often provides the primary responsibility in critical care and pain management. The anesthesiologist is an integral member of the transplant team and this should be recognized by his/her attendance at patient selection meetings and their input.

Initial preoperative evaluations and follow-up

It is quite valuable to have an anesthesiologist involved in the initial evaluation of liver transplant patients for many reasons. First, this gives the anesthesiologist an opportunity to meet the patients and build a relationship early in the disease process. Often when patients are called for a liver transplant they are either too sick or too rushed for the doctor to get to know them. Meeting the patients in advance adds depth to the physician-patient relationship. Secondly, because of

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ISSN 1365-182X print/ISSN 1477-2574 online
DOI: 10.1080/13651820510028927

the complexity of these patients, they commonly have multiple medical issues that require oversight and coordination, especially relating to cardiac and respiratory comorbidities. The transplant anesthesiologist is ideally suited for this role. In our center, we have eliminated many costly consults by having an anesthesiologist in the transplant clinic for preoperative evaluations. Decisions regarding preoperative testing are best made by the trained transplant anesthesiologist, and the results of such testing are then reviewed and interpreted by this same physician prior to approving any patient for candidacy. Finally, this preoperative participation gives the anesthesiologist an opportunity to work with the transplant surgeons in an environment outside the OR. This helps build critical relationships in a more relaxed atmosphere and encourages collaboration regarding perioperative issues.

Critical care

Many liver transplant patients are in need of critical care treatment preoperatively and virtually all require critical care treatment postoperatively. Issues such as fulminant hepatic failure, hepato-renal syndrome, ARDS, and CVVHD require expert care and intimate knowledge of these patients. Ideally the transplant anesthesiologist is also a board certified intensivist who covers both the ICU and the OR. This, of course, is not always possible. More practically, one member of the transplant team should be an intensivist. This physician will alternate time spent in the ICU and the OR and will keep the other anesthesiologists on the team aware of all significant events pertaining to the liver transplant patients in the ICU. In addition, he/she should be in constant communication with the transplant surgeon to make ongoing determinations regarding the candidacy of critically ill pre-transplant patients.

Pain management

Pain control can be problematic in the liver transplant patient. It can be very difficult to control pain in these patients due to the extent of their incisions and their compromised ability to metabolize many pain medications secondary to potential hepatic and renal dysfunction. As the transplant anesthesiologist develops experience with these specific types of patients and is able to follow them more closely, the anesthesiologist becomes expert in the transplant patients' pain management. In addition, the anesthesiologist has been involved with their care since their initial evaluation and has developed a rapport with the patients and their families. This may allow the anesthesiologist to take a more active role in their pain management.

Selection meetings

Attendance at the selection meetings is critical and should be mandatory. It is here where the ultimate decisions are made regarding patient candidacy. Given the role previously described (in the evaluations and follow-up section) the transplant anesthesiologist's input is critical. In addition, these meetings provide an opportunity for the team as a whole to get updates on the progress and condition of post-transplant patients and of those awaiting transplantation.

Administration

There are many administrative duties of the transplant anesthesiologist. These include: staffing and scheduling, protocol development and coordination, and program marketing. These need to be addressed prior to starting a program.

Staffing/scheduling

Assuring adequate attending anesthesiologist coverage and staffing for transplants can be quite cumbersome given the unpredictability of organ availability. A team of trained, experienced physicians must be available for 24/7 coverage. Ideally, the numbers should be such that each individual physician is responsible for at least 15–20 liver transplants per year to ensure upkeep of skills. In addition, several decisions regarding general staffing and training must be made. Questions such as the following need to be addressed in advance: Should we insist on 'one-on-one' coverage for liver transplants? Can we use residents and/or CRNAs? If we use residents, what level of expertise and responsibility should they have? Should they be junior or senior residents? What about ancillary personnel?

It is our feeling that liver transplants are quite complex, maybe the most complex cases of all, and we therefore staff these 'one-on-one' with senior residents (CA2 or above). The complexity of the case, combined with the complexity of the pathophysiology and the ever-present potential for disaster, in our opinion, requires 'one-on-one' attention from the trained, experienced, transplant anesthesiologist, and clearly exceeds the level of junior residents. Although there may be a role for CRNAs, (we do not believe it is wrong to use CRNAs) we are an academic training institution and believe the educational value of these cases mandates resident involvement. Schumann, in a recent study, surveyed liver transplant centers, with responses from 62 (52.5% of all US centers). He found 60% used 2 anesthesia providers in addition to 1–2 ancillary personnel. The attending/resident scenario accounted for 75% of staffing patterns [2].

Protocol development and coordination

The complexity of these cases requires input and support from many groups including the blood bank, perfusion services, laboratory services, clinical pharmacists, nursing, and virtually all consultant services within the hospital. Additionally, various combinations of residents, fellows, and visiting physicians will be

rotating on the transplant service. Therefore, protocols for preoperative evaluation, intraoperative management, postoperative care (ICU and floor), as well as for questions such as when and how to use ancillary services and consultants, must be developed. These groups require education in the form of seminars, grand rounds, meetings, etc., in addition to the formal, written protocols.

Once the protocols are developed, the proper equipment, personnel, etc., must be assured. Questions regarding the use of satellite labs in the OR, the use of the rapid infusion system (RIS) and the use of the thromboelastorgaph (TEG) to guide management of coagulation must be addressed. Schumann's study revealed that 88.7% of centers used satellite labs, 50%–55% used the RIS but only 33% used TEG [2]. In our center, we use an OR satellite lab, the RIS, as well as the TEG. Based on our experience, we have found them all to be quite useful and allow for rapid assessment and treatment in the OR. All necessary equipment exists in the OR, and the appropriate individuals are trained in its use. Perfusion services are utilized to run and manage the RIS and cell saver as well as for veno-venous bypass on the rare occasion we use it.

Marketing

The viability of the transplant program requires the maintenance of relationships with physicians (hepatologists, gastroenterologists, etc.) in the community. Meeting these individuals as a team (surgeon, hepatologist, anesthesiologist, clinical coordinators) helps in assuring the referring physician of a multidisciplinary team approach. In addition, meeting the referring physicians personally helps put a face to a name thus facilitating future communication about patient care over time. It must be remembered that 'word-of-mouth', reputation and results drive the success and viability of transplant programs. Adequate training, planning and experience assures the results end of the equation, but 'face-to-face' (personal) contact and communication with referring physicians and the public as a whole is what helps drive the reputation end.

Education and research

As stated above, education is essential for all groups and individuals involved with the transplant program. Education can take many forms including protocols, meetings, lectures, mentoring, one-on-one teaching, flyers, etc. Specifically, anesthesia resident and fellow education is essential as these cases provide a wealth of clinical material. We have developed a year-round lecture series as well as an individual didactic series for residents and fellows as it pertains to transplant anesthesia and critical care as a whole. As research and education are interrelated, academic transplant centers must be productive from a research perspective. The teamwork required for a successful transplant program yields ample opportunity for a collaborative, multidisciplinary approach to both basic science and clinical research. In addition, as the transplant community as a whole is rather small, opportunities exist for collaborative research with colleagues from other institutions.

Summary

In summary, the anesthesiologist is a vital member of the liver transplant team. It is essential that the anesthesiologist be trained in the intraoperative management of these complex patients as well as in the other perioperative aspects of patient care. The complexity of the patients and their associated surgeries demands a designated liver transplant anesthesiologist. Developing a program that allows for the training of attending anesthesiologists as well as residents in all aspects of perioperative management, as well as administration, education and research, is paramount in the process of becoming a UNOS approved liver transplant center and of its success.

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